UNITED STATES MARINE CORPS
Logistics Operations School
Marine Corps Combat Service Support Schools
Training Command
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FESCR 8108

STUDENT OUTLINE

REPAIR NIEHOFF 220 AMP ALTERNATOR ASSEMBLY

LEARNING OBJECTIVE

1. Terminal Learning Objective: Given a Niehoff Model *N1380-2* 220 amp alternator assembly, the required common and special tools, test equipment, repair parts, shop supplies, and TM 08594A-34&P/11*A*, per information contained in the reference, repair the alternator assembly. (8.1.5)

2. Enabling Learning Objectives: Given a Niehoff Model *N1380-2* 220 amp alternator assembly, the required common and special tools, test equipment, repair parts, shop supplies, and TM 08594A-34&P/11*A*, per information contained in the reference:

a. disassemble the alternator, (8.1.5a)

b. inspect the components of the disassembled alternator to determine their suitability for reuse, (8.1.5b)

c. test the components of the disassembled alternator for serviceability, (8.1.5c)

d. repair or replace the unserviceable components as required, (8.1.5d)

e. assemble the alternator from serviceable components, and (8.1.5e)

f. test the alternator on an appropriate test bench. (8.1.5f)

OUTLINE

1. IDENTIFICATION AND DESIGN CHARACTERISTICS OF THE NIEHOFF MODEL N1380-2 ALTERNATOR ASSEMBLY'S MAJOR COMPONENTS

a. Rotor Assembly. The rotor assembly consists of a shaft and core assembly and two rotors. The rotor positions can be adjusted to minimize output voltage ripple.

b. Heat Sink Assembly. The heat sink assembly contains the rectifier diodes and filter capacitors. It also provides increased heat dissipation to protect the diodes.

c. Front Housing Assembly. The front housing assembly provides connectors and terminals for interconnecting the alternator output and voltage regulator. The upper part contains additional diodes, resistors, and a capacitor for controlling and filtering the alternator output. The lower part contains the bearing for the front of the rotor shaft. Mounting lugs on the assembly are used for alternator installation.

d. Voltage Regulator. The voltage regulator contains a temperature compensated, solid-state voltage regulator. It is a sealed unit with an attached electrical connector to connect it to the alternator.

e. Voltage Adjust Plug. The voltage regulator is equipped with a voltage adjust plug that plugs into the connector on the front housing to select the output voltage. The plug contains a diode and can be connected in three different positions to select one of the three available voltage outputs.

f. Stator and Field Coil Assembly Tube. The stator and field coil assembly tube contains the field coil and two sets of three-phase stator windings.

g. End Housing Assembly. The end housing assembly contains the bearing and oil seals for the fan end of the rotor. It also provides the rear mounting lug for installing the alternator.

h. Fan. The fan provides a flow of cooling air to the alternator. It will provide air flow for either clockwise or counterclockwise rotation.

2. PRINCIPLES OF OPERATION OF THE NIEHOFF MODEL N1380-2 ALTERNATOR ASSEMBLY

a. Alternator Operation

(1) The alternator is belt driven through a pulley connected to the front of the rotor assembly. The rotor assembly consists of a shaft with two, six-pole rotors and a core mounted on it. The rotors turn inside a tube which contains a field coil and two, nine-pole stators. Each of these stators is wound in a three-phase wye configuration.

(2) When battery power is applied to the field coil, a magnetic field is generated in the core. The magnetic field follows a path through the core, front rotor, and stator. It then flows through the outer tube, second stator, and rotor and returns to the core to complete the path.

(3 As the rotors turn, alternate alinement and misalinement of the rotor poles and stator poles occur. This results in the field through any stator pole continually varying between a minimum and a maximum. The varying field generates three-phase AC voltage since the nine stator poles are wound in three series. Each series contains the three poles which are in phase with each other.

(4) The other rotor and stator pair also produces a three-phase output which is slightly out of phase from the first. The phase difference is adjustable by mechanically changing the relative position of the rotor. This allows adjustment to minimize the DC voltage ripple and optimize the output power.

(5) The two, three-phase outputs are rectified and combined by full-wave bridges on the heat sink assembly to produce a steady state DC output.

b. Voltage Regulator Operation

(1) The voltage regulator controls the alternator output voltage by controlling the current flowing through the field coil.

(2) When the external control switch is closed, the output voltage (battery voltage) is applied to the regulator and full field current flows through the alternator field coil.

(3) When the alternator output voltage rises and exceeds the desired output voltage, the zener diode allows current to flow which turns on the driver transistor. This

causes the power transistors within the regulator reduce current flow through the alternator field coil and reduce the output voltage.

(4) When the output voltage drops below the desired output voltage, the zener diode stops conducting. This turns off the driver transistor, and the power transistor is again turned fully on. Field current then increases to increase voltage output. Switching between full field current and a reduced flow provides a regulated DC output.

(5) The output voltage is directly controlled by the temperature sensor Zener diode. The regulator is designed to hold the alternator output at the optimum value needed to properly charge the batteries. This is the function of temperature; therefore, as the ambient temperature rises, the regulator will cause the alternator output voltage to decrease. The opposite will occur if the ambient temperature decreases.

(6) The regulator has an overvoltage protection circuit to protect the charging system in the event of a power transistor failure. In the event that a failure occurs, an SCR will turn on and open a fuse in line with the failed transistor. The respective light emitting diode(LED) will light, indicating a failure has occurred. The regulator is still functional, even though a fault has occurred. If both LED's are lit, there has been two power transistor failures and the alternator will no longer be allowed to produce current.

3. PROCEDURES REQUIRED TO REPAIR THE NIEHOFF MODEL N1380-2 ALTERNATOR ASSEMBLY

a. Cleaning the Alternator Before Disassembly

(1) Find the procedures for cleaning the alternator before disassembly in TM-08594A-34&P/11A. Read the procedures completely to become familiar with the total task.

(2) Explain to the instructor the procedures for cleaning the alternator.

b. Disassembly of the Alternator Assembly

(1) Find the procedures for disassembly in TM 08594A-34&P/11A. Read the procedures completely to become familiar with the total task.

(2) Disassemble the alternator.

(a) Break the torque on the locknut that secures the fan to the alternator. Then remove the pulley, woodruff key, and spacer from the alternator.

(b) Remove the regulator.

(c) Remove the heat sink assembly.

(d) Remove the fan assembly.

(e) Remove the end housing.

(f) Remove the rotor.

(g) Remove the front housing assembly.

STOP! Have instructor initial. _____

c. Cleaning of the Components

(1) Find the procedures for cleaning in TM 08594A-34&P/11*A*. Read the procedures completely to become familiar with the total task.

(2) Demonstrate or explain to the instructor the procedures for cleaning the components.

d. Visual/Mechanical Inspection

(1) Find the procedures for inspection in TM 08594A-34&P/11A.

(2) Demonstrate to the instructor the procedures for inspecting the components.

e. Electrical Checks

(1) Find the procedures for performing the electrical checks in TM 08594A-34&P/11A. Read the procedures completely to become familiar with the total task.

(2) Demonstrate to the instructor the procedures for the electrical checks. Have instructor initial.

f. Assemble the Alternator from Serviceable Components

(1) Find the procedures for reassembly in TM 08594A-34&P/11A. Read the procedures completely to become familiar with the total task.

(2) Assemble the alternator.

(a) Reassemble the stator and field coil assembly tube.

(b) Install the rear rotor.

STOP! Have instructor initial. _____

(c) Install the end housing.

(d) Install the fan assembly.

(e) Install the heat sink assembly.

(f) Install the voltage regulator.

NOTE: The outer face of the pulley to be used when testing the alternator on the alternator/generator/regulator/starter (AGRS) test stand should be painted half white and half black before installation.

(g) Install the spacer, woodruff key, pulley, and locknut.

STOP! Notify the instructor when you have the alternator reassembled. _____

g. Test the Alternator on the Alternator/Generator/Regulator/ Starter (AGRS) Test Stand.

NOTE: An instructor will be at your test stand to provide you with individual instructions and assistance while you test your alternator.

(1) Install the alternator on the test stand.

(a) Position the alternator on the test stand mounting bracket pins. Secure it in place, using the pin

bracket crank and by connecting the top holding bracket to the top mount of the alternator.

(b) Install two **3VX450** belts on the test stand and alternator pulleys. Aline the belts and adjust their tension by turning the two bracket table cranks.

(2) Connect the cable assemblies.

(a) Connect cable **1508B** to the positive output cannon connector on the alternator and into the positive 24 volts socket of the test stand. Plug cable **1527** and the small lead from cable **1508B** into the **GEN RES 50 OHMS** red receptacle on the test stand. Plug the other end of cable **1527** into the oscilloscope **CH1** red receptacle on the test stand.

(b) Connect cable **1512** to the negative terminal of the alternator and into the negative socket of the test stand. Plug cable **1529** into the oscilloscope **CH1** black receptacle on the test stand and to the negative output connection of the alternator.

(c) Connect cable **1521** to the **0-36 VDC 20A** power supply and the **UUT** bus sensing cannon connectors on the test stand.

(3) Adjust the speed sensor.

(a) Make sure the louvers are in the open position and that all five air inlets on the test stand are open.

(b) Turn the test stand main power switch to the ON position. Turn the control power switch, located on the lower right side of the control panel, to the **ON** position.

(c) Adjust the speed sensor until you have a defined red dot on the reflector. Rotate the drive pulley by hand to see if the RPM register on the pulley drive RPM meter. If they do not register, readjust the sensor and recheck.

(4) Perform the alternator output test.

NOTE: The **UUT** cover must be in the down position before the drive will operate.

(a) Turn the **UUT** voltage switch to the 24V position. The 24 volt load bus voltage green indicator light should be on at this time.

(b) Turn the **UUT** ground polarity switch to the NEG position. The bus grounding negative green indicator light should be on at this time.

(c) Turn the drive motor rotation switch to the CCW position. The drive motor **CCW** green indicator light will start blinking.

(d) Turn the drive motor switch to the **START** position. The load bank fan, glycol coolant pump, and the drive motor lube pump green indicator lights should be on at this time.

(e) When the drive motor green indicator light stops blinking, turn the drive motor speed adjust until the pulley drive RPM meter indicates 1500 RPM.

(f) Turn the voltage regulator switch to the **ON** position. The alternator should self-excite at this time, as indicated on the 24 volt **GEN/ALT** volts meter. If the alternator does not self-excite, turn the DC power supply switch to the **ON** position and rotate the DC power supply volts adjust ***SLOWLY*** until the 24 volt **GEN/ALT** volts meter reads **28 (+-) 1 volt.** As soon as this occurs, return the DC power supply controls to the OFF position.

(g) With the 8 load steps rotary switches in the OFF position, turn the load bank control switch to the ON position.

(h) Slowly apply a 20 amp load, utilizing the 24 volt load steps rotary switches as applicable. The amps will be read on the 24 volt **GEN/ALT** amps meter. Allow a 15 minute warmup time for the alternator.

(i) Increase speed to 3,000 RPM. Check the volts on the 24 volt **GEN/ALT** volts meter. With the 20 amp load applied, the volts should be **28 (+-) 1 volt.** If the volts are not within the specifications, refer to paragraph 2-8 of the technical manual, for troubleshooting.

(j) Turn the speed down to 1600 RPM. Slowly apply a load until the volts drop to **28 (+-) 1 volt**. If the load applied is less than 100 amps, refer to paragraph 2-8 of the technical manual, for troubleshooting.

(k) Increase the speed to 8,000 RPM. Slowly apply a load until the volts drop to **28 (+-) 1 volt**. If the load applied is less than 220 amps, refer to paragraph 2-8 of the technical manual, for troubleshooting.

(l) Decrease the load to 20 amps and the speed to 1600 RPM.

(5) Measure the peak-to-peak output voltage ripple, using the oscilloscope.

(a) Press the oscilloscope power button to the **ON** position and wait for the self-tests to complete. Completion of the tests will be indicated on the screen.

(b) If when the oscilloscope self tests are complete, no waveform is displayed on the screen after about three seconds, press the **AUTOSET** button and wait three seconds. The autoset feature of the oscilloscope will automatically set most of the front panel controls. The instrument will trigger on the waveform, display at least one complete cycle, and center horizontally on the screen.

(c) You can use the vertical and horizontal position knobs to move the displayed waveform up, down, left, or right.

(d) Use the **VERTICAL VOLTS/DIV** knob to set the vertical divisions to 5 volts as indicated at the top of the display screen.

(e) Use the **HORIZONTAL SEC/DIV** knob to set the desired rate of the waveform.

(f) Set the cursors to measure delta volts (peak-to-peak, output voltage ripple).

1 Press the cursor button and the cursor menu will be displayed on the screen.

2 Press the button under the D volt of the menu to **ON**, as indicated on the display screen.

3 Use the general purpose knob to move the first cursor along the waveform as a reference point for the measurement.

4 Press the toggle button to activate the second cursor. Use the general purpose knob to move the cursor along the waveform to the point where you want to make the measurement in reference to the placement of the first cursor.

5 The delta voltage, (peak-to-peak, output voltage ripple), will appear at the top of the display screen. The voltage ripple shall not exceed 15 volts.

NOTE: If the voltage ripple is to high, the rear rotor may be adjusted relative to the front rotor. The fan must be removed and the rotor mounting nuts loosened. The rotor may then be rotated. Tighten the nuts and reinstall the fan; then repeat the ripple test. This adjustment may need to be repeated several times. If movement of the rear rotor does not correct the problem, the front rotor may also need to be moved. This will require removal of the heat sink assembly to gain access to the rotor and its mounting nuts.

(g) Press the oscilloscope **POWER** button to turn the oscilloscope off.

(h) Return all load bank controls to the **OFF** position.

(i) Turn the drive motor speed adjust down to zero, the voltage regulator switch to **OFF**, and the drive motor switch to the **STOP** position.

(j) After the blower stops, turn the control power and test stand main power switches to the **OFF** position.

(k) Remove the alternator from the test stand and return the cable assemblies to their original location.

REFERENCE:

TM 08594A-34&P/11A